

REMARKS

Claim Objections

Claims 3, 5, 6, 7, 18 and 39 are objected to for an alleged lack of antecedent basis. In response Applicant has amended each of these claims to provide sufficient antecedent basis for the recited "natural period". Also, Applicant respectfully points out to the Examiner that other time periods, i.e., other than the "natural time period", are also recited in the claims and that it is incorrect to consider "any time period involved in the ejection process" as being the "natural time period." For example, "a time period" is recited that refers to the duration of time between the beginning and ending portions of the excitation portion of the drive signal.

Claim Rejections

Claims 14, 16, 17-29, 33 and 36 are rejected under 35 U.S.C. § 102(b) as being anticipated by Teramae et al. (EP 1 023 997).

Claims 1, 2, 4, 6, 7, 9, 13, 14, 16, 17, 23-26, 31, 34, 35, 37-39 and 43 are rejected under 35 U.S.C. § 102(e) as being anticipated by Anderson et al. (6,116, 717).

Claim 3 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Anderson et al. (6,116,717) in view of Milbrandt (4,631,548).

Claim 5 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Anderson et al. (6,116,717) in view of Jacobs et al. (4,704,675).

Claim 8 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Anderson et al. (6,116,717) in view of Nagoshi et al. (6,224,182) and Jacobs et al. (4,704,675).

Claims 10-12, 32 and 40-42 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Anderson et al. (6,116,717) in view of Arthur et al. (5,049,898).

Claim 30 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Teramae et al. (EP 1 023 997) in view of Nagoshi et al. (6,224,182) and Jacobs et al. (4,704,675).

For the reasons set forth below, Applicant respectfully traverses the rejections and requests favorable disposition of the application.

Additionally, Applicant has amended claims 14 and 17 to clearly recite the provision of a rank indicator.

Discussion

As stated previously, the present invention is directed to a method of classifying an ink jet recording head and an ink jet recording head classified by the method. To provide suitable suppression of meniscus vibration in the recording head, even when the *natural period* of ink in the pressure chamber varies, for example, due to variations in the shape of the pressure chamber in the recording head and the compressibility of the ink, the present application discloses and claims a method whereby the natural period of the ink pressure fluctuation is measured in each of a plurality of recording head and the recording heads are then classified into ranks based on the measured natural period of each recording head. In particular, independent claim 1 recites, *inter alia*;

executing a plurality of times, individual
ink droplet ejections from the nozzle orifice,
while varying an ejecting condition;

identifying a correlation between ejecting conditions and ejecting results based on the plurality of ink droplet ejections; and classifying the assembled recording head into a plurality of ranks, based on the identified correlation.

§102 Rejection in view of Anderson et al.

The Examiner asserts that all the features set forth in claims 1, 2, 4, 6, 7, 9, 13, 14, 16, 17, 23-26, 31, 34, 35, 37-39 and 43 are anticipated by Anderson et al. Applicant submits that at least because Anderson et al. fails to teach or otherwise suggest the recited identifying and classifying steps of claim 1, Anderson et al. does not anticipate claim 1.

Anderson et al. not only fails to teach certain explicit features of the claimed invention, but the method disclosed in Anderson et al., moreover, is expressly disclosed in the present application as one that should be avoided. In particular, it is recognized in the specification of the present application, at page 3, lines 17-20, that "if a separate or independent waveform is established in respective recording heads, the cost of production will be worsened, wherein it would become difficult to carry out mass production in view of time and cost, etc." In other words, the inventors of the claimed invention recognized the possibility of driving each recording head with its own respective and unique drive signal, or waveform, based on the natural period of the recording head. The inventors, however, discounted this possibility since doing so would be cost prohibitive.

To address the problems discussed above, i.e., accommodating variations the *natural period* of ink in the pressure chamber, for example, due to variations in the shape of the pressure chamber in the recording head and the compressibility of the ink, one of the embodiments of the

claimed invention includes identifying, for each recording head, a correlation between ejecting conditions and ejecting results and *classifying the recording heads into a plurality of ranks* based on the correlation.

For example, one embodiment of the invention includes driving a plurality of recording heads with a number of drive signals, each having a different pulsewidth. The amount of ink ejected or, alternatively, the velocity by which it is ejected, is measured for each different pulsewidth drive signal. A correlation is then drawn between the pulsewidth and either the amount of ink ejected, or the velocity of the ejected ink, to determine a natural period of the recording head. Each recording head is then classified into one of a number of ranks based on the correlation. For example, three different ranks might be selected, one representing the recording heads for which the natural period is as expected, i.e., per the design criterion of the recording head. Another rank might represent the recording heads for which the natural period is shorter than the design criterion, and a third rank might represent those recording heads for which the natural period is greater than the design criterion. The ranking of each recording head can be associated with the respective recording head and the recording head can be controlled, accordingly. For instance, a unique waveform is used to drive each of the ranks.

By classifying the recording heads into a finite number of ranks and driving each rank with a respective drive signal, instead of driving each individual recording head with its own unique individual drive signal, it is possible to efficiently suppress meniscus vibration in a manner that is conducive to mass production.

Anderson et al. discloses a version of the very method discounted by Applicants as being inefficient and which exhibits at least one of the very problems to which the present invention is addressed. Specifically, Anderson et al. discloses a method in which various offset tables are determined to adjust the pulsewidth of the drive signal for each print head based on “resistance measurements made across the array of heater elements” when ink is ejected from the print head. (Col. 4, line 14). Accordingly, a *separate or independent waveform is established in respective recording heads* in a manner precisely like the one sought to be avoided by the claimed invention. Furthermore, Anderson et al. discloses controlling the pulsewidth for sections of heaters within a print head or even for each individual heater. Thus, making the Anderson et al. method even more inefficient as compared to the claimed method.

For at least the reason discussed above, Anderson et al. does not anticipate claim 1, or any claims dependent thereon. Accordingly, claims 1-13, 17-29 and 31-43 are believed to be allowable over the cited prior art.

§102 Rejection in view of Teramae

The Examiner asserts that the features set forth in claims 14, 15, 17-29, 33 and 36 are anticipated by Teramae. Applicant respectfully disagrees. In particular, independent claim 14 and claim 17 have been amended to recite a rank indicator. Teramae does not disclose a rank indicator and, thus, does not anticipate either of claims 14 or 17. Accordingly, claims 14 and 17, and any claims dependent thereon, in particular, claims 15-16 and 18-30, respectively, are allowable over Teramae.

In regard to claim 36, Teramae fails to teach or suggest the recited identifying and classifying steps as discussed above in regard to claim 1. Accordingly, Teramae does not anticipate claim 36.

§103 Rejections

None of the other asserted prior art references compensate for the deficiencies of Anderson et al. and Teramae as discussed above. Thus, for similar reasons to those discussed above in regard to at least independent claims 1, 14 and 17, none of the prior art references, either alone or in combination, teach all the features of dependent claims 3, 5, 8, 10-12, 30, 32 and 40-42. Accordingly, for at least this reason none of these claims are rendered unpatentable by the prior art.

Patentability of New Claim

For additional claim coverage merited by the scope of the invention, Applicant has added new claim 44. Applicant submits that the prior art does not disclose, teach, or otherwise suggest the combination of features contained therein. For example, none of the prior art references teach or otherwise suggest ranks that are associated with a plurality of correlations. Support for the subject matter recited in new claim 44 is found in at least Fig. 7.

Conclusion

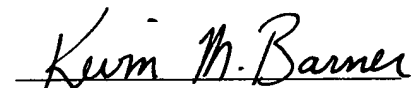
In view of the foregoing amendments and remarks, the application is believed to be in form for immediate allowance with claims 1-44, and such action is hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or

AMENDMENT UNDER 37 C.F.R. § 1.111
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telephone interview, he is kindly requested to **contact the undersigned** at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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